

ROCK CHARACTERISTICS IMPORTANT IN REPOSITORY SITING—PERMEABILITY, POROSITY, SOLUBILITY, THERMAL STABILITY, AND SORPTIVE CAPACITY

The purpose of a geologic repository is to safely isolate high-level radioactive wastes from the surface environment. Students should understand what factors must be considered prior to determining that isolation can be accomplished. Wastes will be carried from the repository in fluids, either gases or liquids. The fluid of primary concern is ground water that may ultimately become drinking water. You may wish to highlight recent concerns over radon gas build-up in buildings to illustrate gas phase transport of a radioactive contaminant.

In the history of the radioactive waste repository selection process, the Yucca Mountain site is unique. It is the only site to receive serious consideration that is above the local water table; i.e., in the unsaturated zone. The pore spaces in the rocks surrounding the repository are not filled with water, but with air. This situation gives the site several advantages, but it also raises a few interesting questions.

Advantages in building the repository above the local ground water table include easier construction and less need for manmade barriers to keep water from immediately entering the repository. Over the long term, it is less likely that corrosive waters will interact with and degrade the waste containers. In a similar vein, it is more likely that water soluble components of the waste are not going to be mobile in a dry environment.

On the other hand, air-filled pores will not absorb and dissipate as much of the heat generated by radioactive decay as effectively as water-filled pores might. Heat build-up in the rocks near the repository may be a problem. Finally, the possibility of gas phase transport of a few radioactive species (e.g., iodine-129) has to be considered. Gas phase transport was never a very important consideration in a saturated zone repository wherein the water solubility of a gas and its subsequent transport in solution were prime considerations.

Isolating nuclear wastes from the environment requires methods of long-term containment. Containment implies containers, or barriers, that act to stop the movement of the wastes. The high-level waste repository will incorporate the multiple barrier containment concept. Multiple barriers act like containers within containers. The innermost waste container is the solidified waste form itself. The solidification process reduces the solubility of the wastes, thereby making them less mobile. The next containment barriers are the engineered (or manmade) canister and the engineered canister receptacle that is built into the host rock. The container of primary interest in this reading material is the host rock itself.

From the standpoint of rock characteristics important in repository siting, the chemical composition and atomic ordering of the minerals are critical to the chemical sorption and ion exchange capabilities of the rock. Slight, allowable variations in the chemical composition within the fixed atomic arrangement can dramatically increase or decrease the exchange capacity of the mineral and, thereby, the rock.